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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/782,558	02/13/2001	Carlo Rubbia	P-6150	9660

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EXAMINER	
PALABRICA, RICARDO J	
ART UNIT	PAPER NUMBER
3641	

DATE MAILED: 10/16/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/782,558	RUBBIA, CARLO	
	Examiner	Art Unit	
	Rick Palabrica	3641	

-- The MAILING DATE of this communication appears on the cover sh et with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE ____ MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *25-45,47-70,72 and 73* is/are pending in the application.

4a) Of the above claim(s) *30,31,35,51,56 and 57* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *25-29,32-34,36-45,47-50,52-55,58-70 and 73* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *13* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

1. Applicant's amendment in Paper No. 15, dated 9/25/02, correcting the specification, canceling claims 1-24, 46 and 71, and amending claims 25, 26, 40, 45, 47, 49, 52; 65, 70 and 72, is acknowledged.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 25-29, 32-34, 36-45, 47-50, 52-55, 58-70, and 73 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Independent claims 25 and 49 recite the limitations "front face" and "rear face". There is insufficient antecedent basis for this limitation in the claims.

Independent claims 25 and 49 recite the limitation "means for cooling the wall of said chamber from a rear face thereof". This limitation is vague and indefinite because it can be interpreted in several ways, e.g., a) the means for cooling, such as a pump, is physically located a point behind a "rear face" of the chamber; or b) the "rear face" of the chamber is being cooled by a cooling means.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 25, 26 and 32 are rejected under 35 U.S.C. 102(b) as being anticipated by any one of Arino et. al (U.S. 3,940,318) or Wieneck et. al (U.S. 5,615,238) or Wieneck et. al (U.S. 6,160,862).

Applicant's claims read on any one of the claimed inventions disclosed in the above references. Said inventions are for the production of radioactive fission products, such as ^{99}Mo, from targets irradiated by neutrons in a nuclear reactor. Any one of the three references disclose a cylindrical target comprising either a fissile material coated on the inside surface of a cylindrical chamber (e.g. see column 6, lines 24+ in Arino et. al) or a fissile foil bonded to the outer surface of an inner target cylinder, said inner cylinder enclosed by an outer target cylinder (see Abstract of the two Wieneck et. al references). When these cylindrical targets are placed in a nuclear reactor, their outside walls are inherently cooled by the reactor coolant. Also, most of the fission products generated by the fissions of the fissile material due to neutron irradiation are in gaseous form.

Applicant's claim language reads on any one of the three inventions as follows: a) "chamber having wall coated with fissile material on front face" reads on "cylindrical

target with fissile material on the inside"; b) "gas" reads on "gaseous fission products released from fissioning of fissile material in the target"; c) "means for cooling wall of chamber from rear face" reads on the reactor coolant that is inherently present in the nuclear reactor where the targets are deployed.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 25, 26, 28, 29, 32, 33, 36-45, 47-50, 52, 54, 55, 58, 59, 61-70, and 73 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pettus (U.S. 5,289,512) in view of any one of the combinations of Bingham et. al (U.S. 4,759,911) – Culver (U.S. 5,873,239), Bingham et. al – El-Genk (U.S. 5,428,653), or Bingham et. al – Rom (U.S. 3,202,582). Pettus discloses the applicant's claims except for the specifics on the fissile material-coated chamber, propellant, material and cooling of the reflector.

Pettus discloses a space engine comprising a gas heating device (Fig. 4, numeral 52) and a means for expelling the heated gas into space to generate thrust (see nozzle 18 in Fig. 1). The gas-heating device comprises at least one chamber that is tubular in shape and having ^{242m}Am, in the form of a carbide (see column 2, last full

paragraph and column 3, lines 3-7). Fission reactions in the gas-heating device are caused by leakage neutrons from the first core (see Fig. 2, numeral 14, and column 1, lines 40-41). Pettus further discloses a neutron reflector surrounding the enclosure of the gas heating device, said reflector having cavities for receiving removable neutron-absorbing control rods (see Fig. 2, numeral 25 and column 2, lines 7-14). The gas-heating device is in communication with the exhaust nozzle through a throat provided in the neutron reflector (see Fig. 1).

Pettus does not disclose a fissile material coating for the chamber. However, Bingham et. al disclose a gas-cooled fuel element for space power and propulsion applications (see column 1, lines 10+). Bingham et. al show this fuel element in their figure as a cylinder wherein americium carbide is coated on the cylinder base material (see column 2, lines 40+).

Any one of Culver, El-Genk or Rom teach a nuclear rocket with a core, reflector and a chamber cooling circuit that is separate from the propellant circuit. All three references teach the "means for cooling the chamber" as being located at a "rear face" of said chamber (e.g., see numeral 4, Fig. 4 in El-Genk and numeral 34, Fig. 2 in Culver).

Rom uses hydrogen as a propellant/coolant and graphite as reflector (see column 3, lines 37-40). Note in Fig. 1 of Rom cooling for the chamber wall 44 is provided by hydrogen gas flowing into the inlet manifold 25. This manifold reads on applicant's claim language "means of cooling the wall of said chamber from a rear face

thereof". Note that this manifold is clearly shown as being at the rear face of chamber 21.

As stated by the Examiner in the 4/17/02 Office Action, the limitation in said claims regarding the use of ^{7}Li as coolant is a well-known expedient in the nuclear art because of its good heat-absorbing capacity and its low molecular weight, and so to use ^{7}Li as a substitute coolant for hydrogen would be prima facie obvious.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the nuclear rocket, as disclosed by Pettus, by the teachings of any one of the combinations of Bingham et. al – Culver, Bingham et. al – El-Genk, or Bingham et. al – Rom, in order to have a space engine, comprising: 1) at least one chamber has a coating of fissile material on a front face; 2) a means for cooling the wall of said chamber from a rear face thereof; 3) a heated propellant gas of hydrogen; 4) a neutron reflector of carbon material (graphite); 5) a cooling medium of molten metal (i.e., ^{7}Li); and 6) a cooling medium is circulated in a circuit having a first portion on a face of the reflector adjacent to the hot gas collecting region and a second portion located in the fuel region. This modification is no more than the use of conventionally known designs/techniques within the nuclear rocket art.

5. Claims 27, 34, 53 and 60 are rejected under 35 U.S.C. 103(a) as being unpatentable over any one of the combinations of Pettus - Bingham et. al – Culver, Pettus- Bingham et. al – El-Genk, or Pettus-Bingham et. al – Rom, as applied to claims 25, 26, 28, 29, 32, 33, 36-45, 47-50, 52, 54, 55, 58, 59, 61-70, and 73 and further in

view of IDS document C2, Chikin et al. "Gas Heating by Fission Fragments in the Channel of a Pulsed Reactor," Atomnaya Energiya, December 1988, USSR, Vol. 65, No. 6) and Etherington (Nuclear Engineering Handbook). The combination as discussed above in section 8 discloses the applicant's inventive concept except for the specifics on the thickness of the fissile material and the reflector.

As to the limitation in said claims of having a fissile content of lower than 10 mg/ cm^3, Chikin discloses a gas-filled channel of a pulsed reactor wherein a layer of highly enriched nuclear fuel (90% ^{235}U) of thickness 2.5 microns is applied to the inner surface of the graphite wall of said channel. Fission fragments from said fuel heat the gas similar to the claimed inventive concept. Based on a density of uranium = 19 gm/cm^3 (e.g., see H. Ethrington, Nuclear Engineering Handbook), the thickness of the nuclear fuel is equivalent to 4.7 mg/cm^3.

As to the limitation regarding the reflector having a thickness of at least 50/d, where d = density of carbon material, this yields a thickness of at least 22 cm, based on a graphite density of 2.22 gm/ cm^3. Etherington teaches that graphite has a thermal diffusion length = 51.8 cm (see Table 24, page 1-20). As stated by the Examiner in the 4/17/02 Office Action, it is well known in the nuclear art that a reflector should have a thickness of at least one thermal diffusion length in order to be effective, and to use a 51.8 cm thickness for the graphite reflector would have been prima facie obvious.

Modification of any one of the cited combinations to have included the teachings of Childin and Etherington would have been obvious to one having ordinary skill in the

art at the time the invention was made, as such results are in no more than utilization of known techniques in the nuclear art.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rick Palabrica whose telephone number is 703-306-5756. The examiner can normally be reached on 8:00-4:30, Mon-Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Carone can be reached on 703-306-4198. The fax phone numbers for the organization where this application or proceeding is assigned are 703-305-0285 for regular communications and 703-305-0285 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist, telephone number is 703-308-1113.

RJP
October 10, 2002

MICHAEL J. CARONE
SUPERVISORY PATENT EXAMINER